

Reproductive Biology of *Boiga guangxiensis* Wen, 1998 (Serpentes: Colubridae)

Sergei A. Ryabov^{1*} and Nikolai L. Orlov²

¹ Tula Exotarium, Oktyabrskaya, 26, Tula 300002, Russia

² Zoological Institute, Russian Academy of Sciences, Universitetskaya Nab. 1, St. Petersburg 199034, Russia

Abstract Up to now, the reproductive biology of most species of the genus *Boiga* is investigated very little. Important data on the reproductive biology of *Boiga guangxiensis* were received by us for the first time. The investigations were carried out in Viet Nam during expeditions and in the laboratories of Tula Exotarium in the period between 1998–2000. The data on the feeding, egg size, incubation, size of hatchlings, and juvenile colouration of this species are provided for the first time. In addition, the data on size and ratio of snout-vent length/tail length of this snake are provided based on the Vietnamese samples. Our researches demonstrated that *B. guangxiensis* is distinguished from most other species of the genus by a number of peculiarities of its reproductive biology. Also, morphological differences between Chinese and Vietnamese individuals of this species were noted.

Keywords *Boiga guangxiensis*, reproduction, juvenile colouration, Viet Nam

1. Introduction

The Guangxi Cat Snake, *Boiga guangxiensis*, was recently described from Guangxi in China by Wen (1998). In Viet Nam, *B. guangxiensis* was previously identified as *B. cynodon* by Campden-Main (1970), and Nguyen and Ho (1996).

This species was mentioned as *Boiga nigriceps* (Zhao and Adler, 1993). It is distributed in many parts of Viet Nam, including Lao Cai, Cao Bang, Lang Son, Thai Nguyen, Vinh Phuc and Bac Giang provinces in the north, Quang Binh, Kon Tum and Gia Lai provinces in central, and Lam Dong, Tay Ninh and Dong Nai provinces in south Viet Nam (Nguyen *et al.*, 2009). We also observed this species in the forest near Son Kim Commune, Huong Son District of Ha Tinh Province. This species is also known from Laos (Orlov and Ryabov, 2002). Most of the species of *Boiga* are rarely kept in captivity, and only little is known about their reproductive biology.

Since 1998, a scientific-practical research program for

the reproductive biology of cat snakes has been developed and conducted both in the Tula Exotarium and in Zoological Institute of the Russian Academy of Sciences. At present, data on reproduction of 10 species of *Boiga* have been collected. *B. guangxiensis* was one of the studied species. Based on the previous work of the program, this research was then carried out.

2. Material and Methods

2.1 Adaptation and keeping One male and three females of *B. guangxiensis* were kept for breeding in Tula Exotarium in 1998–2006. They were collected in April 1998 from Hoang Hoa Tham Commune, Chi Linh District in Hai Duong Province, Viet Nam.

Adaptation of the snakes to the terraria conditions was rather simple and rapid. Each individual was kept in a plastic box with a size 60×35×40 cm. The boxes were equipped with comfortable crossbars and branches for climbing. The temperature inside the boxes was maintained at 27–31°C in the warm corner and at 23–24°C in the cold corner at daytime, but at 22–23°C at night. Humidity in the terraria was 80%–90%, and it was achieved by every-day spraying of the substrate of crumpled filter paper.

*Corresponding author: Dr. Sergei A Ryabov, Director of Tula Exotarium, with his research focusing on investigation of Asian snakes.

E-mail: sergryabov@mail.ru

Received: 19 May 2010 Accepted: 27 July 2010

2.2 Diapause At the end of October 1998, the temperature was reduced to 15–17°C and the time of light treatment was shortened to 8 hours in a day for all the captive individuals of *B. guangxiensis*. Food was not offered at that time. The humidity was kept lower than usual (50%–60%). In our experiment, the duration of the diapause was two months.

3. Results and Discussion

3.1 Research in the field In the mountains of Tonkin and Annam this species is quite common, but it is rarely encountered in the southern provinces of Viet Nam (Orlov *et al.*, 2003). The maximum known size is 1700+440 mm (Zhao, 2006). Our additional specimens were collected from Tam Dao in the north (ZISP 25512–25517, ROM 28438), from Kon Tum in the central (ZISP 25852), and from Cat Tien and Chu Yang Sin National Parks in the south Viet Nam (VNMN TAO 242, 506, 543), respectively. The largest specimen has the size of 1540+475 mm (SVL + TaL). It is noted that the ratio of snout-vent length/tail length (L/Lcd) of the Vietnamese specimens is a bit smaller than that of the Chinese specimens (2.8–3.2, $n = 10$ versus 3.53–3.86, $n = 3$). The source of the data on the Chinese specimens is from Zhao, 2006.

In the wild, *B. guangxiensis* lives among low young trees (at the height of 2–5 m above the ground) often near large streams in primary and secondary tropical forests or in karst regions. This is a nocturnal species. The cat snakes crawl over from one low tree to another, holding their bodies nearly straight and parallel to the ground. Birds prevail in their diet, as well as reptiles and rodents. Repeatedly in the wild-caught specimens, excrements with birds' feathers were observed, occasionally with scales and hair.

3.2 Feeding The cat snakes spend most time in the hiding-places, and they crawl out from those places only in the evening after the light in the laboratory is switched off. The major problem is in providing the snakes with suitable food because the wild-caught snakes mainly eat birds. The snakes in the boxes, in spite of repeated offers, never ate small chickens, but preferred quails covered with feathers. Owing to a wide mouth, these snakes can easily cope with a very large prey. Subsequently, young and subadult individuals were observed eating young mice, baby-rats without hair and lizards. Some individuals grew up on the diet consisting mainly of laboratory rodents.

Also force-feeding of wild-caught snakes with rats and mice was used after long rejection of the offered feeding objects. In our experiment, *B. guangxiensis* could not easily digest the hair of adult mice. That is why young rats or mice without hair were usually offered to the snakes. On the average the snakes ate once in every 7–14 days. When the snakes were taken out of diapause, and after 3–4 feedings, all the captive snakes gained weight.

3.3 Reproduction On 28, February at the very first gathering in the evening a copulation was observed and it lasted for about 15 minutes (Figure 1). Subsequently repeated copulations with different females were observed, and the duration was from 10 to 20 minutes (10 matings). From all species of *Boiga* which took part in our experiments, only *B. guangxiensis* had copulation in such short time. For comparison, the mating durations of *B. dendrophila* (3 subspecies), *B. cyanea*, *B. cynodon*, *B. nigriceps*, *B. drapaezii* and *B. irregularis* lasted from 2.5 to 4 hours, and those of *B. kraepelini*, *B. ceylonensis* and *B. multomaculata* for 10–20 hours (Ryabov *et al.*, 2004, pers. data).



Figure 1 Copulation of *B. guangxiensis* in captivity in Tula Exotarium (Photo by Ilya S. Korshunov)

After mating females greedily ate twice, and then they did not want to take any food. Gravidity in this species in our experiment lasted from 36 to 49 days. The main data on the reproductive biology of *B. guangxiensis* are given in Table 1.

Table 1 Data on reproductive biology of *B. guangxiensis*

No. of ♂♂ and ♀♀ in experi-ment	Duration of matings(minutes)	Duration of gravidity (days)	No. of eggs per clutch	Size of eggs			Duration of incuba-tion, (days)	Sizes of young snakes			Total No. of clutches
				Length (mm)	Diameter (mm)	Weight (g)		SVL min-max (mm)	TL (mm)	Weight (g)	
♂	♀										
1	3	10–20	36–49	3–10	39–53	16–20,5	12–19,8 on the average 14,5	88–106	335–365	116–135	7,7–11,2 on the average 9

During 1999–2006, the authors received nine clutches of eggs, and of them seven were obtained from the females in captivity after a complete cycle of breeding and two from wild-caught gravid females. In 2000, two clutches were produced by one female in one season, that is, one was produced on 25 March and the other on 26 May. It is likely that in favourable years second clutches are also possible in the wild, but this is rather an exception than a rule. Whereas, *B. cynodon*, *B. cyanea*, *B. dendrophila*, and *B. nigriceps* were capable to give 3–4 clutches per year (Ryabov, 1999). The shell of the eggs is thick, leathery, but without such marked longitudinal grooves as in *B. cynodon*.

Under the conditions of incubation at 25–27°C, the hatching of eggs of *B. guangxiensis* requires a period of 88–106 days. On the whole, this period of time is close to the duration of incubation of other species, *B. cynodon* requires 100–115 days (Ryabov *et al.*, 2006), *B. dendrophila* (3 subspecies.) 89–117 days (Ryabov and Orlov, 2002), *B. nigriceps*–106 days, *B. irregularis* subsp. -82 days and *B. cyanea* 98–120 days (pers. data).

Juvenile colouration of this species had not been described in the literature before. Young individuals of *B. guangxiensis* have bright-orange colouration with a semitransparent neck and dark-orange transverse bands (Figure 2). They differ considerably from yellowish-grey adults which have a washed out pattern (Figure 3).



Figure 2 A juvenile of *B. guangxiensis* in captivity in Tula Exotarium (Photo by N. L. Orlov)



Figure 3 An adult of *B. guangxiensis* from Tam Dao, North Viet Nam (Photo by N. L. Orlov)

In 2008, we found several juveniles in Mau Son Commune, Loc Binh District in Lang Son Province. When the snakes were raised at Tula Exotarium, we observed that subadults (at the age of 7–12 months) had an intermediate colouration of the body (Figure 4).



Figure 4 A subadult (10 months of age) of *B. guangxiensis* in captivity in Tula Exotarium (Photo by N. L. Orlov)

Usually, there are no special problems in raising *B. guangxiensis*. Most of the young snakes have to be force-fed. They are doing well on a diet of one-week old mice, and in a year they increase their size approximately twice (S. Prohorchick, pers. comm.). Some individuals begin to eat pinky-mice on their own. It is stated that frequent feedings can cause malfunctions in digestion. That is why it is recommended to offer food to young

B. guangxiensis in the same way as to adults, often not more than once in every 7–10 days. Many young cat snakes even with force-feeding at the age of a year and a half grow up to such degree that they can easily swallow a young quail. And after that all young snakes begin to feed on their own.

The change in the bright juvenile colouration begins at the total length of 70–75 cm at the age of 7–9 months, and the orange colouration gradually changes to grey-orange and to grey colouration. In the second year of their life, the juveniles of *B. guangxiensis* look similar to adults. Sexual maturity is attained in the third year of life.

In the present article the data about duration of copulation, feeding, incubation, sizes of eggs and young individuals of *B. guangxiensis* are provided and reported for the first time. Also, the data about the juvenile colouration of this species and the methods of adaptation in captivity, breeding and raising of its young snakes are given for the first time. Our researches demonstrated that *B. guangxiensis* differs from most other species of the genus by some peculiarities of its reproductive biology. Also, morphological differences between Chinese and Vietnamese individuals of this species were observed.

Acknowledgements The authors express their thanks to their colleagues for their help in this research; to Robert Murphy (Royal Ontario Museum, Toronto, Canada) and Cao Van Sung, director of the Institute of Ecology and Biological Resources (IEBR, Hanoi, Viet Nam) for organizing the expedition; to Svetlana Popovskaya (Tula) for collecting clutches and young snakes; and also to Oleg Shumakov (Moscow), Sergei Prohorchick (Minsk), Oksana Tishenko (Tula), Yury Nevalenny (Tula),

Ilya Korshunov (Tula) for their help in preparing this article.

References

Campden-Main S. M. 1970. A Field Guide to the Snakes of South Vietnam. Washington D.C., U.S: Nat Mus Smithsonian Institution, 114 pp

Nguyen V. S., Ho T. C. 1996. [Danh lục bò sát và ốc sên Việt Nam. Nha Xuất Ban Khoa Hoc Va Ky Thuật]. Hanoi: Sci Technol Publ, 262 pp (In Vietnamese)

Nguyen V. S., Ho T. C., Nguyen Q. T. 2009. Herpetofauna of Vietnam. Frankfurt am Main: Edition Chimaira, 297–298

Orlov N. L., Ryabov S. A. 2002. A new species of the genus *Boiga* (Serpentes, Colubridae, Colubrinae) from Tanahjampea Island and description of “black form” of *Boiga cynodon* complex from Sumatra (Indonesia). Russ J Herpetol, 9: 33–56

Orlov N. L., Ryabov S. A., Nguyen V. S., Nguyen Q. T. 2003. New records and data on the poorly known snakes of Vietnam. Russ J Herpetol, 10: 217–240

Ryabov S. A. 1999. [Numerous clutches in representatives of sub-order snakes (Serpentes)]. Moscow: Scientific Researches in Zoological Parks, 11: 110–118 (In Russian with English summary)

Ryabov S. A., Orlov N. L. 2002. Breeding of black mangrove snake *Boiga dendrophila gemmicincta* (Dumeril, Bibron et Dumeril, 1854) [Serpentes: Colubridae: Colubrinae] from Sulawesi island (Indonesia). Russ J Herpetol, 9: 77–79

Ryabov S. A., Kudryavtsev S. V., Korshunov I. S. 2004. [Reproductive biology of Large-toothed tree snake *Boiga cynodon* (Boie, 1827)]. Moscow: Scientific Researches in Zoological Parks, 17: 29–32 (In Russian with English summary)

Zhao E. M., Adler K. 1993. Herpetology of China. Ohio, Published by Society for the Study of Amphibians and Reptiles, USA: Oxford, 230–231

Zhao E. M. 2006. Snakes of China, Vol. I, Anhui: Anhui Science and Technology Publishing House, 180–181